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Smart Home Technology and The Needs of the Aging Population in Southern Ontario

By

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SMART HOME TECHNOLOGY

AND THE NEEDS OF THE AGING POPULATION

IN SOUTHERN ONTARIO

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ABSTRACT

The care-needs of the aging population of Southern Ontario, in addition to the support-needs of formal and informal caregivers, is ever-changing. The implementation of Smart Home Technology has been successful throughout Europe. While such research is lacking in Southern Ontario, the need for support is evidently growing. Smart Home Technology is defined as any type of technology that assists older adults to live independent, safe lives, by promoting health and wellbeing among users. Little research has attempted to understand the technology needs of the aging population, and none have focussed on the technology needs in long-term care, nor have taken the knowledge of front-line staff into consideration. Therefore, this qualitative study seeks to understand smart home technology needs in a long-term care home in Southern Ontario. This inquiry is based upon the opinions of Personal Support Workers (PSWs), nurses, and therapeutic recreationists. Data collection was pursued through open-ended face-to-face interviews (N=10). Data was transcribed, coded, and thematically analyzed into three major themes: existing technology; needed technology; and the realities of care workers' daily work and tasks. Essentially, these findings have the ability to add to smart home technology literature and research, and provides a needs assessment for a typical long-term care home in Southern Ontario.

INTRODUCTION

As the aging population of Canada continues to rise, new methods of support need to be implemented into home-settings to support older adults. A common support prevalent in Europe includes Smart Home Technology, considered to be a branch of eHealth (also known as Health Informatics). The eHealth discipline attempts to connect physicians and technologists in order to improve the mode of healthcare and patient wellbeing. Smart home technology is defined as any type of technological aid that assists an older adult to live in a home setting, whether it be assisted living, community living, or a private dwelling (Brandt, Samuelsson, Toytari & Salminen, 2011; Demiris et al., 2004). Through the use of telemonitoring, data collection algorithms, and monitoring and controlling the physical environment, the older adult is able to live independently in a safe setting (Brandt, et al., 2011; Demiris et al., 2004).

The implementation of such technology in European care realms has been deemed successful. However, such innovations have not been tested nor implemented in Southern Ontario. With the increasing older population and its ever-changing needs, further research is needed to investigate the potential for smart home technologies in Ontario.

In Southern Ontario, Personal Support Workers (PSWs) are the backbone of institutionalized care. Unfortunately, PSWs increasingly experience staff shortages, adverse work environments, and lack of political pull (Lilly, 2008). Thus it is of importance to understand possible alternative methods of support, one being smart home technology. The possibility of improving employee integrity and in turn, improving health and wellness of the respective residents is a concept that should be researched and perhaps optimized. Furthermore, the needs of the aging population will continue to change, and adaptation is necessary.

This undergraduate dissertation seeks to identify smart home technology needs in a long-term care setting in Southern Ontario. At this stage of the research, long-term care is defined as an institution that houses older adults who need 24-hour support and care. Through open-ended face-to-face interviews (N=10), the knowledge, opinions and experiences of personal support workers (PSWs), nurses, and therapeutic recreationists were taken into account. The interviews were recorded, transcribed and thematically analyzed in order to understand the technology needs at this specific long-term care home located in Southern Ontario.

LITERATURE REVIEW

Smart home technologies include, yet are not limited to: motion sensors, vital sensors (Demiris, Hensel, Skubic & Rantz, 2008a), assistive devices, telemonitoring, and telehealth phone services (Chan, Campo, Esteve & Fourniols 2009; Courtney, Demiris, Rantz & Skubic, 2008; Rialle, Duchene, Noury & Bajolle, 2002). Within the literature, smart home technology is also referred to as a health smart home (Demongeot et al., 2002; Rialle et al., 2002), telemonitoring (Meystre, 2005), or gerontechnology (Bouma et al., 2007; Fozard, Rietsema, Bouma & Graafmans, 2000; Mahmood, Yamamoto, Lee & Steggell, 2008). A majority of the smart home technology literature derives from European countries. Few technology-based peer-reviewed articles derive from

Canada, let alone Southern Ontario. None of the smart home technology and technology-based literature seek the opinions and attitudes of front-line staff despite their everyday, 24-hour care experiences. As eHealth reforms are on the Ontario health agenda, eHealth based research is desirable to understand technology-based care needs.

Categorizing Smart Home Technology

As characterized in the literature, smart home technology needs can be categorized in four ways: physiological, physical, cognitive, and environmental.

1. ***Physiological Needs.*** Smart home technology for physiological needs includes technology that monitors the individual's organs and vital signs. This technology can also maintain the functionality of a given organ (e.g. heart pacemaker) (Chan et al., 2009; Demiris et al., 2004; Demongeot et al., 2002; Koch & Hagglund, 2009; Meystre, 2005). This medium has the potential to link the patient through communications to the physician (Chan et al., 2009; Meystre, 2005; Rialle et al., 2002). Linkage is done through the syncing of automatic health status records from the patient to the physician's computer (Chan et al., 2009). For example, telemonitoring can constantly monitor heart rate, breathing, sleep, and automatically deliver the information to a practitioner (i.e. nurse, physician, caregiver). Although telemonitoring is idealistic, the impacts and results with respect to maintaining health have been inconclusive (Pare, Jaana & Sicotte, 2007). Further research must seek to understand the direct impacts telemonitoring has on health and wellbeing (Pare et al., 2007). However, Barlow, Sing, Bayer and Curry (2007) infer that smart home technology for physiological needs creates positive outcomes for users through facilitating empowerment, autonomy, and constructive behaviour changes. Issues and concepts regarding telemonitoring will be discussed in the following.

2. ***Physical Needs*.** Smart home technology for physical needs supports older adults in terms of their physical functionality. This includes smart home technology that can analyze the function and status of an older adult's gait, as well as assistive devices for patients; an example being wheelchairs (Demiris et al., 2008a; Demiris et al., 2004). Additionally, smart home technology for physical needs can greatly benefit fall prevention; as falls have been found to be the first indication of health status and wellness decline in older adults (Demongeot et al., 2002). Falls can be further detected with Sixsmith and Johnson's (2004) thermal imaging camera, and also through a system designed to automatically alert an ambulance post-fall events (Demiris, Oliver, Dickey, Skubic & Rantz 2008b). Ideally, a system like this could be implemented in Canadian home-settings. Further research must first take place to understand whether such technologies are applicable.

3. ***Cognitive Needs*.** Smart home technologies for cognitive needs are unique as they can assist the older adult with personalized Activities of Daily Living (ADLs) and Instrumental Activities of Daily Living (IADLs) (Demiris et al., 2008b; Soar & Seo, 2007). ADLs are considered to be routine daily activities (i.e. bathing, dressing, eating,

and toileting) (Fried & Guralnik, 1997). Contrasting, IADLs are activities that usually require more competence than ADLs: driving, shopping, cooking, and paying bills (Fried & Guralnik, 1997). This cognitive assistance is done through a collection process where data patterns and algorithms are compiled to detect change in personal routines (Chan et al., 2009; Courtney et al., 2008; Demiris et al., 2008b; Soar & Seo, 2007). This is considered to be preventative-based technology. These data patterns also fall under the first category—smart home technology for physiological needs—as they are able to track physiological changes within the body (Demiris et al., 2008b). Soar and Seo (2007) present an interesting context-wise smart home technology for cognitive needs which cues the older adult with reminders for certain IADL performance (e.g. preparing tea).

4. ***Environmental Needs*.** Last, smart home technology for environmental monitoring can alleviate stress among users through an alarm system that can, for example, detect intruders and monitor kitchen appliances (Demiris et al., 2008a). This type of smart home technology can also detect environmental hazards including gas leaks and fires (Brandt et al., 2011; Demiris et al., 2008b). Additionally, it can automatically monitor lights and temperature (Brandt et al., 2011; Demiris et al., 2004). Smart home technology for environmental monitoring not only alleviates the stress induced by IADLs and ADLs, but protects the older individual from potential risks that are not often checked nor easily detected.

It is evident that when all four categories of smart home technology are implemented, both independence and safety are achievable. This type of research should take place in a Southern Ontario long-term care context as there is limited research available, and a shortage of allocated PSWs. There is a clear need to assess modes of further support.

The four categories presented above can be compared to Demiris and Hensel's (2008) findings, who through a systematic literature review categorized smart home technology into six categories including: internal monitoring (measurement of vitals); functional monitoring (measurement of activity levels, gait, and diet); monitoring of safety (detecting potential hazards); social interaction (this measures the social interaction and social activity in which the older adult participates); security monitoring (for potential threats); and reminder systems (to assist with memory) (Demiris & Hensel, 2008). However, this systematic review of smart home technology does not include any information derived specifically from Ontario.

Models of Smart Home Technology

Ideal smart home technology models are prevalent throughout Europe. Originating from France, Chan et al. (2009) present a model of an integrated Smart Home. This Smart Home consists of the four outlined categories. It contains vital health and activity level measurement systems, assistive devices, home control devices, telehealth services, and entertainment devices (Chan et al., 2009). The entire system uses algorithms to monitor data collected from the individual, and connected to external facilities for monitoring. These facilities monitor and respond to changes and

emergencies; they could include a hospital, nursing home, long-term care home, or a nursing hub (Chan et al., 2009). Though expensive, Chan et al.'s (2009) model has been deemed successful. Although there is a clear need for technology of this type, such a system has not yet been used in a Canadian context.

Telemonitoring

Telemonitoring is the automatic and constant monitoring of an individuals' bodily health (Barret, 2012; Kastner et al., 2010; Pare et al., 2007). In the UK, telemonitoring is becoming more prevalent to support the needs of older adults with chronic conditions (Barret, 2012). Although the benefits are still inconclusive, telemonitoring allows nurses to be to more proactive and efficient (Barret, 2012). Further, telemonitoring is an important step in achieving 'community care,' which is deemed as a positive element in geriatric health care (Kastner et al., 2010). Through their telemonitoring trial, Kastner et al. (2010) observed that older adults utilized the telemonitoring technology well; it is perceived to facilitate patient autonomy and confidence. Pare et al. (2007) infer that patients comply with telemonitoring technologies. Although telemonitoring is deemed promising, further studies are needed to understand the cost-effectiveness of such technologies (Pare et al., 2007).

Challenges are prevalent within telemonitoring innovation. Nurses still need to observe patients regularly as observations are fundamental in health care (Barret, 2012).

Theoretical Perspectives

An aging-in-place theoretical framework is embedded within the smart home technology literature. This is important since such systems encourage an independent and safe living environment where the older adult can successfully age (Brandt et al., 2011; Bharucha et al., 2009; Chan et al., 2009; Sixsmith & Johnson, 2004). Specific examples of smart home technology that promote aging-in-place are outlined by Soar and Seo (2007), who describe a context-aware reminder system. For example, if an older adult turns on the teakettle, a speaker-system will explain where to locate the tea bag, and will further remind the individual to drink the tea (Soar & Seo, 2007). This type of system may be applicable to many Canadian home settings, whether it be independent living, assistive living, or long-term care.

From a different point of view, Coughlin, D'Ambrosio, Reimer, and Pratt (2007) conducted focus groups with a sample of "elites" to gain a unique perspective. The sample included directors of long-term care homes and hospitals, and other leaders from the sector. Results indicate that encouragement and implementation of an aging-in-place perspective is prevalent in the long-term care sector; participants feel that it is necessary to support and improve overall wellness (Coughlin et al., 2007). Smart home technology enables the older adult to live safely and independently as necessary precautions are put in place (Bouma, et al., 2007). This framework is essential within related research and development as there is a widespread desire to age independently in one's own home (Rantz et al., 2005). Research is required to understand how the given family and caregiver(s) are affected by these technologies. A possible research question includes: to what extent does smart home technology alleviate stress on caregivers?

In contrast, Brandt et al. (2011) identified and understood environmental control systems (ECS) in a micro-structural functionalism framework. ECS are considered as a smart home technology that works in the given setting to identify gas leaks or fire threats (Brandt et al., 2011). These researchers use a micro-structural functionalism framework in order to analyze the ECS to exemplify how, together, the individual and technology function to promote overall safety and independence. This interesting framework attempts to understand the interaction between the individual and the technology, and is thus useful in analyzing how smart home technology works best with the user (Brandt et al., 2011). Although both smart home technology and ECS have been found to support overall safety and independence, not enough research has been completed to fully understand to what extent smart home technology can positively affect the health of older adults (Brandt et al., 2011). In comparison to the Brandt et al. (2011) study, Mahmood et al. (2008) utilize a conceptual framework that outlines the importance of both technology and social interaction to promote the same goals (safety and independence). Although this relates to Brant et al.'s (2011) findings of interdependence with smart home technology and ECS, a social aspect is emphasized (Mahmood et al., 2008). This social aspect encourages the older adult to participate in activities and interactions with others through technology, while monitoring the frequency and authenticity of the interactions (Mahmood et al., 2008). Micro-structural functionalism and a conceptual framework both speak to a positive notion of aging-in-place.

Safety and Independence

Much of the relevant literature promotes health, safety, and independent living through smart home technology. Its implementation leads to overall wellness by providing a safe environment via vital monitoring systems that monitor bodily functions such as oxygen levels, heart rate, and glucose intake (Meystre, 2005). However, more research is needed to understand technology needs for older adults who have dementia (Meystre, 2005).

Motion sensors on the bed, stove, and throughout the floor plan of the home correlate with higher feelings of safety and independent living (Demiris et al., 2008a; Soar & Seo, 2007). A safety feature protecting against intruders left users feeling the most comfortable (Demiris et al., 2008a). All of the technologies mentioned work to promote a safe and independent lifestyle, as older adults are able to live alone in their private homes due to alarm mechanisms (Chan et al., 2009; Demiris & Hensel, 2008; Rantz et al., 2005; Soar & Seo, 2007). These mechanisms, however, are reactive and not proactive (Demiris & Hensel, 2008). This needs to be improved as issues such as falls would require much less attention if prevented rather than monitored. Rigorous prevention therefore precedes implementation of reaction. Thus, more preventative research is needed.

Telemedicine—a telephone-based medical information system—was proven to be beneficial (Chan et al., 2009). Telemedicine allows the older adult or caregiver to telephone for medical assistance without having to physically go to the doctor (Chan et al., 2009). However, the overall mechanisms of telemedicine need to be improved for effective and efficient functionality. Specifically, knowledge transfer needs to be made more clear (Chan et al., 2009). Telemedicine ideally assists the individual with health needs, and provides a sense of comfort in case health assistance is required (Chan et al., 2009).

Canada's Home Telehealth agenda seeks to deliver health-based information services (COACH, 2013). Ideally, health information is sought through and received through one's own telephone or computer (COACH, 2013). According to COACH's (Canada's Health Informatics Association) (2013) Canadian Telehealth report, Ontario's Home Telehealth program is in place and expanding.

Issues of Privacy

A large quantity of the research identified privacy concerns amongst current and potential smart home technology users (Chan et al., 2009; Coughlin et al., 2007; Courtney et al., 2008; Demiris et al., 2004; Demiris et al., 2008a; Mahmood et al., 2008). Older adults are concerned with data and records access; who will be able to view the footage from cameras that are used (Coughlin et al., 2007; Demiris et al., 2008b)? However, a later study by Demiris et al. (2008a) determined that older adult user safety and security outweighed privacy issues.

Issues of privacy can be alleviated with certain designs of smart home technology. By greying out in-home cameras, older adults felt that they were made more anonymous, which alleviated their privacy-related anxieties (Demiris et al., 2004). Comparatively, Sixsmith and Johnson (2004) developed Simbad; a thermal imaging camera designed to detect falls. Simbad was then empirically tested through lab experiments followed by a field experiment—the purpose being accuracy (Sixsmith & Johnson, 2004). Simbad was proven to detect falls accurately, and although alleviation of privacy was not tested, results of the study did show that the individual would remain anonymous as identities were undetectable (Sixsmith & Johnson, 2004). Further research must focus on how these types of technologies might fit into living spaces.

Population Needs

In regards to support needs, a Southern Ontario-based study attempted to understand the needs of older adults living in private dwellings (Czarnuch & Mihailidis, 2011). This research design included an 84-question survey, which attempted to determine the support needs of older adults through the experiences of their family caregivers (Czarnuch & Mihailidis, 2011). Results infer technological supports are desired to assist with: personal care and hygiene; nutrition and diet; and housework and medication (Czarnuch & Mihailidis, 2011).

Canadian long-term care homes located in rural areas lack economic feasibility and technological support (Skinner & Rosenberg, 2006). There is a need for innovative and updated technologies amongst the Canadian long-term care setting to determine if smart home technologies can assist in long-term care.

Methods in the literature used focus groups to gather opinions regarding smart home technology from either cognitively-aware older adults (Demiris et al., 2008a; Demiris et al., 2008b; Demiris et al., 2004); and an elite population including leaders from the sectors of: long-term care homes, retirement facilities, and nursing realms (Coughlin et al., 2007); and family caregivers (Czarnuch & Mihailidis, 2011). Although these research methods made valid contributions to the literature, the needs of older adults who have dementia must also be heard. Dewsbury (2001) emphasizes the importance of evidence-based technology. It is essential to understand the needs of the population at hand. Thus, it is vital to perform the given research with the population for which the technology

is intended. This research could be pursued through observations of care workers (PSWs, Nurses, etc.) in long-term care homes as they are the providers of constant 24-hour care.

Gaps within the Literature

The literature lacks evidence in understanding *how* smart home technology could best support older adults in Southern Ontario (Demiris & Hensel, 2008). Moreover, only one relevant Canadian literature source was available for review. More exploratory research is necessary to understand what types of smart home technology are needed and where they are needed, while much of the current research focuses only on the types of technology available. A suitable area to begin a study is in a long-term care setting reviewing the needs of older adults who have dementia. An ideal sample includes PSWs and support staff who work in the same long-term care home. This is directed towards the front-line workers who embody the everyday (and every-night) processes of the institution. The knowledge of PSWs on related issues is extremely valuable. This would add to the current body of smart home technology literature for a number of reasons: a sample of PSW opinions has yet to be used within published articles, a long-term care home has not been a place of research, and Southern Ontario has not had such a study. As the population continues to increase, more methods of support must be considered. The needs of older adults will continue to evolve so adaption is essential.

It is evident that smart home technology is of value and can improve the overall health and wellness of older adults through enabling safety and independence. As Canada's population is continuously aging, it could indeed be of use, but further research is needed to identify the current support needs in long-term care. A long-term care setting is an ideal place to start, as there are many aging individuals, and many formal caregivers who embody knowledge gained from their experience. This inquiry would overall enhance the current body of literature by contributing a new perspective from a long-term care perspective.

Research Questions

The following research questions have guided this inquiry:

- What technologies that promote safety and independent living are currently being utilized and how effective are they?
- What other technologies are needed to support older adults living in long-term care?
- Do smart home technology concepts have a place within long-term care, and if so, what types are needed?

This study attempts to identify what smart home technologies would be most beneficial in a long-term care setting, if any.

METHODOLOGY

Rationale

The purpose of this qualitative study is to understand whether there is a need for smart home technology in a long-term care home in Southern Ontario. This research is relevant as currently no Canadian peer reviewed articles have attempted to understand technology needs in long-term care. Additionally, no relevant technology peer reviewed articles have attempted to grasp the needs of this population through the opinions and attitudes of care workers (PSWs, nurses, therapeutic recreationists, etc.).

As a researcher, I was previously employed at the place of research. From May 2014 to August 2014 and from May 2015 to August 2015, I served as a therapeutic recreation student in this long term care facility. The data collected are based on the experiences and opinions of the home's PSWs, nurses, and therapeutic recreationists. Data were collected via face-to-face open-ended interviews. This study attempts to identify whether smart home technologies would be most beneficial in a long-term care setting, as much of the European-based literature indicates that there are opportunities for such innovations. This study proposal was approved by the McMaster Research Ethics Board in May of 2015.

Sampling and Recruitment

PSWs were chosen as subjects of study as they can provide an array of information. PSWs are the sole providers of 24-hour care to the older adults living in the long-term care home and can therefore speak to the needs of the residents who have dementia. Additionally, nurses and therapeutic recreationists were also invited to participate for comparison purposes. Nurses provide essential medical care, oversee the care-based operation of the home, and act as nurses-in-charge. They understand the overall mechanisms of the home. Last, therapeutic recreationists provide the social element of care. Therapeutic recreationists often have close-knit relationships with the residents. At times, they are able to speak to the residents' intrinsic needs. The experiences embodied within all three positions contain valuable information that is often overlooked in health technology research. It is assumed that PSWs, nurses, and therapeutic recreationists all may provide valuable information independently of one another. Through this heterogeneous sample, three main aspects of care were addressed: everyday tasks and living (PSWs), medical care (nurses), and the social aspects of daily life (therapeutic recreationists).

Purposive sampling was utilized to recruit participants. In the workplace I, as the researcher, verbally invited PSWs, nurses, and therapeutic recreationists to participate in the study. Snowball sampling was also used as participants spoke to other staff about the study, who then volunteered to participate.

Data Collection and Analysis

Qualitative research methods were utilized to collect data from participants. Face-to-face interviews were chosen for data collection to ensure a more thorough response rate. Interviews also provide an opportunity to clarify the participant's responses. Each participant participated in one interview lasting 10-15 minutes. The interview script consisted of eight open-ended questions.

Each interview was recorded with the participants' permission for thorough verbatim transcription to ensure reliable data. Minimal notes were taken during the interviews. This mode of note taking was utilized in order to not distract the participant; it was beneficial to pay full attention to what was being said.

The desired number of interviews was completed once theoretical saturation was reached (N=10). Data were then transcribed manually by the researcher into a secure computer database. Post transcription, the data were coded and thematically analyzed. Words, phrases, attitudes and ideas expressed by the interviewees were all of interest. Themes include: existing technologies; needed technology; and the realities of care workers' daily work and tasks.

RESULTS

Participant Characteristics

Participants had been employed at the home for an average of 9.1 years. The longest employment period at the home was 15, and the lowest was 4. On average, participants indicated that they were responsible for 20.8 residents at a time. Seven participants believed this was the least number of residents they were responsible for, and three believed this was the most. *Please see Figure 1.* For comparison, there wee 41 beds at the institution. Most, if not all, had some form of dementia or Alzheimer's.

Figure 1

Participant Characteristics				
	Number of Years	Avg. Residents Responsible For	Most/Least	
	6	41	Most	
	4	41		Least
	15	10		Least
	5	12	Most	
	6	21	Most	
	14	10		Least
	6	11		Least
	9	41		Least
	12	10		Least
	14	11		Least
TOTAL	9.1	20.8	M= 3	L=7

Existing Technologies

Existing technologies in the home function, but are not ideal. Participants mentioned bed alarms, door alarms, the call bell system, and the video camera located by the nurse's station.

1. ***Bed Alarms*.** The bed alarms are used to alert care staff if a resident gets out of bed. The bed alarms consist of pads connected to a remote and alarm when a resident is at-risk for unsafely getting out of bed. Participants agree that the bed alarms alert care staff when this occurs. However, participants emphasized how detrimental these alarms can be. Unfortunately, these *shrill and obtrusive* alarms ring inside the room at the bedside and not at the door. This often scares and disturbs the resident and, if present, their roommate as well.

   A common comment amongst participants was how often the bed alarms fail when they prematurely go off. Moreover, when residents move within their own bed; they are very sensitive. A participant shared a story about a resident at risk for climbing and falling out of bed:

   > *"The bed alarms... you have to place it so when the person moves, here… perfect example: on of our residents likes to pull up her feet, and as soon as she pulls up her feet, it alarms…and you go in, and she's like 'well, what?' …It would be better if it was a different type of monitoring. If the pad isn't in the perfect spot and they roll off… or they go off when the resident is sound asleep."*

   Another participant exemplified the common malfunction of the bed alarms:

   > *"But then sometimes it would malfunction, and if you turn a little bit in bed the sensor goes off. It wakes up the resident, scares them, or the roommate, or the person across the hallway…because it is very loud. It would be better if they had a sensor that was hooked up to the pager system like we have. And then it would go off on the pager and then you could go to that resident."*

   Usually a bed alarm is paired with a crash mat. Placed on the floor beside the bed, a crash mat is a soft and plush plastic mat. The crash mat serves to protect the resident from directly hitting the floor if they were fall out of bed. However, there are few crash mats and they are not always paired with bed alarms. One participant who was positive about the alarms was particularly concerned as to why a bed alarm is often installed without a crash mat:

   > *"I like the bed sensors, only if they are accommodated with a floor mat. And that's not the case. To me, sometimes I compare the two jobs* [bed alarms and crash mats]*—but when you have a bed alarm, they always have a crash mat. But that's not the case here. So that's the consistency with keeping things together."*

   Participants agreed that the bed alarms serve their purpose and function. However, they felt these features institutionalize the environment by creating hospital-like

sounds and mechanisms. Participants developed these opinions through residents' comments and attitudes.

2. ***Door Alarms*.** The door alarms in the home serve to warn care workers when a resident at risk for wandering is near the restricted perimeter, and to alert care workers when the given resident exits the restricted perimeter. The door alarms are placed at all exits leading out of the home. There are two door alarms at the home; one door alarm exits to the front of the building, and the other exits to a hallway which leads to another area of the facility. Residents who are at risk for wandering wear wander guard bracelets. Please see *Figure 2* for a similar wander guard concept. The wander guard bracelets look like hospital bracelets with rectangle boxes on them. In simplest terms, this bracelet transmits location data to the door alarms which trigger the alarm sound when necessary.

Figure 2

Although secure, when visitors or staff enter the building through either door, at risk residents often exit. When the given resident exits the restricted perimeter the alarm sounds. A staff member or care staff is then required to enter the code for the alarm to halt, and to proceed to retrieve the resident. Participants explained how residents believe it is a bothersome fire alarm. Further, some participants said there is limited time to get to the door, enter the code and retrieve the resident. Moreover, at certain times care workers/staff may not check an alarm for a number of minutes. Participants had concerns about these time constraints. Since there are tasks in the home, having limited time often creates issues between staff, care delivery and outcome. A participant explains the time restraint with the door alarms:

> *"Once again, time restraint. If we don't have staff on the floor, an alert could be going at the other end of the hall and we are all down at this end, or we have someone on a lift* [who cannot be left alone] *and that alert is going and going, in order for someone to get to the other end, it is very difficult."*

A participant described how the door alarms are insulting to a resident:

> *"She is cognitively aware, and doesn't think she has any cognitive issues and finds it very insulting that we think she would run away, or that we have to come up and shut off the alarm for her. This lady always lets out her very confused friend out of the door. This lady*

wears a wander guard so the bell rings very loudly when she does this, and she waits at the door until we shut it off; she never exits."

Another issue with the door alarms pertains to the wander guard bracelets themselves. Participants spoke to residents' adverse, and at times aggressive behaviour towards the bracelets. Participants speculate that residents attempt to cut or rip them off because of the way they look, and coincidentally make them feel: "*…people are looking at their arm thinking 'what is this thing, why is it on me. It's really ugly, please take it off."*

3. ***Call Bell System*.** The call bell system in the home works like a typical call bell system in a hospital. Each resident has two call buttons; one by their bed and one in their bathroom which is typically located by the toilet. The purpose of the call bell is to alert the staff of a resident need or emergency. These call bells are also located in various bathrooms around the home and in the tub room (where residents are bathed/showered). Typically, only the PSW bathing a resident would pull the call bell in the tub room. When this call bell goes off the PSWs *run* as they know it is usually an emergency.

   Participants feel that the call bells serve their purpose, but are generic:

   "I think we need a better call system here…right now it's so generic… where I find a bell could be ringing, and its like you try to get there… but it should be a different sound where you knew it was an emergency and actually go to that person. We need a better system for emergency calls on the floor."

   With the call bell system, there is a three-minute fail safe time for the nurse-on-duty. If a call bell has not been answered in three minutes, the nurse will intervene. However, participants explained how the nurse does not have time to intervene. This issue is exacerbated when there is only one nurse on the floor which often happens on evenings and nights.

   PSWs are often put in pairs to toilet and take care of residents. Some residents require two PSWs for care tasks (i.e. toileting), and others need one. However, communication between PSWs is often compromised when they are completing separate tasks (i.e. toileting respective residents). Maintaining communication is attempted, but often unsuccessful.

   Participants' attitudes and experiences infer the call bell system is not being utilized to its full potential. A participant shared this excerpt:

   "We don't have different codes for things, just one code of alert… and you can tell if they pulled the cord in their bedroom or bathroom. If it

is a bathroom call you know it's a little more urgent. But yeah you need to know your room numbers, some of the staff don't know room numbers so its not an effective tool, and it is not being used effectively."

Overall, participants feel that the call bell system is useful, albeit not always to its full potential.

4. ***The Video Camera*.** When asked about any further technology in the home, many participants spoke about the one video camera. The video camera records activity in a secluded television area (zone 6 in the home) where at times, residents are placed or retreat to relax and/or watch television. This video camera transmits a live-video feed to a small television located at the nurse's desk/station. This television is easily seen by all individuals located in that area. However, it is not very noticeable as it is located high on the wall parallel to the nurse's station. A participant explained the issue of this area:

"We have a camera, but because it is always on, it becomes part of the furniture so people don't always look at it...zone 6 is unmonitored for significant lengths of time. It has happened where a resident has fallen over there and it took a while for someone to find them. So, even a resident in his own bathroom fell, and it took time for staff to respond. So it would sure be helpful, even in a small home."

This area is not highly supervised as it is not always a common area for care staff to observe. Participants were uncertain about how much staff looked at the cameras. One participant commented:

"…like the camera, there are certain drawbacks to it. People don't look at those monitors very often and they aren't very clear… and if the sun is shining just right at the camera, you can't see anything…but I know if staff put [a resident in zone 6] *in the evening they will check it a little more often…that certainly is not the best system because it requires someone to look at it, instead of being automatically notified."*

Overall, participants felt that the technology functions, but not ideally. Participants commonly understood the obtrusive technology (i.e. bed alarms; door alarms) to be disruptive to residents. More specifically, these noisy systems do not allow the home to feel like *a home.* The mechanisms and noises of the home make it feel like an institution.

Needed Technology

Stressors. Four of the ten participants perceive falls as the most apparent workplace stressors. Six participants feel that their biggest stressors are lack of time to complete care tasks. When asked to elaborate, the participants felt that because of staff shortages and allocated PSW hours, corners are often cut. Participants feel that the repercussions of these issues directly affect residents as the care is not always comprehensive. Participants discern that certain technologies have the potential to improve this workplace reality.

1. ***Preventative and Evidence-Based Technology*.** When asked about technology-based support needs, participants want to see more evidence-based and preventative technology, especially for fall prevention. A participant explained a technology-based notion that they think would be of great use:

> *"I think more thought should be put into trying to figure out why they are getting up, why they are agitated…* [we] *need hands on, right? It's not to see the fall, its to prevent the fall. If* [there were] *more PSWs, more hours, we would have more attention paid, we would be more aware because more people would be going by. So,* [an internal telemonitoring concept] *would be great, but that's just something* [that can] *notify."*

2. ***Communication.*** Participants feel that a more automatic mode of internal communication would be beneficial (i.e. between the PSWs and nurse(s)). Participants believe that an improved internal communication innovation would improve care, and care outcomes:

> *"And sometimes* [PSWs] *are so understaffed, or when* [the PSWs] *have the three o'clock meeting and no one is on the floor, and* [other staff] *have to interrupt to tell* [the PSWs] *so and so needs to go to the bathroom, or someone has fallen."*

Further speaking to internal communication, a participant shared a concern with updating care-based information. This participant believes this aspect of daily care is in need of improvement:

> *"…the concerns are updating information. If someone is going from minced to puree [food], or if someone now wears stockings, that's not always updated. But that is important and it needs to be* [better communicated]."

3. ***Telemonitoring.*** Participants believe internal telemonitoring could support more thorough care. Overall, participants feel intrigued about innovative technologies such as telemonitoring. As participants explained that their major

workplace concerns are falls, telemonitoring could be of use. With the potential use of telemonitoring, staff could be automatically notified of the fall: who, where and when. Care staff would utilize less time locating the nurse on duty, and more time responding. Regarding the response to the fall, decision making could potentially be more clear and efficient if the telemonitoring device would automatically indicate the resident's vitals to the nurse. Participants in the study shared these frustrations:

> *"We would be able to know exactly where they are, we wouldn't have residents who have fallen that we have no idea where they are, who can't reach the call bell and who are just waiting. We don't know how long they* [have] *been waiting for. Has it been 15 or 20 minutes? If we are providing care for someone, how are we supposed to know that someone has fallen? We could go from one room to another and not know."*

> *"I think* [telemonitoring] *would be good because sometimes you walk by in the hallway and they are just sitting there. And then you wonder how long they've been on the floor for and no one knows… and I think falls are one of the worst things that can happen. I am just so worried about* [a resident] *because* [they are] *so healthy, and one day I am so afraid* [they] *will fall and decline."*

> *"…especially on nights* [telemonitoring] *would be lovely. Because on nights it is only three of us* [two PSWs and one nurse]*. If we're down here and someone falls and were doing rounds at the other end, we don't know what's going on there. If someone falls they have to wait until we get there and we go 'oh where are they?' So that would be nice,* [to know] *if someone has fallen."*

Another participant explained how being constantly aware of a resident's vitals could assist with care and progress when they are palliative. This could potentially give the family a more thorough prognosis. Furthermore, one participant felt that telemonitoring would be a good emergency response system as nurses and PSWs could automatically be aware of all emergencies.

Amongst participants, concerns with telemonitoring innovations arose. Apprehensions included issues with technology malfunctions. Further, participants believe telemonitoring would fail if it bothered or confused the resident, similar to the wander guard bracelets; the medium of telecommunication should be discreet (i.e. watch; necklace; something the resident would enjoy wearing). Last, there was trepidation about issues of sensitivity. A participant wondered whether care staff would develop adverse reactions to the alarms: *"oh it's just him again."*

Realities of Care Workers

Although the original purpose of this study was to understand technology needs in a long-term care home, psychosocial, physical and political realities were also very apparent themes.

Time Constraints

Six of ten participants said that care staff feel that they do not have enough time to properly complete necessary care and work tasks. Throughout the interviews, participants spoke to how having minimal time to complete various care tasks affects the wellbeing of residents:

> *"The time restraint…*[we're] *very rushed. The time spent with the resident is very rushed… and trying to have a conversation with the resident is limited because you are rushed. You can't give them what they need* [friendship; connection]. *They could be feeling lonely, and wanting to have someone to talk with. And you can't, you have to move it along and it's a horrible feeling. Very much so."*

> *"…which is why we keep pushing for more staff. More staffing on the floor. If there was more staff, there would be more of a home-like atmosphere. You would be able to spend that needed quality time with the resident."*

The therapeutic recreation department encourages all staff in the home to facilitate Montessori activities with the residents. Montessori consists of encouraging residents to participate in and complete tasks that may interest them (i.e. arranging flowers). Participants understand that the social aspect of care is fundamental to wellbeing, while at the same time feeling like there is not enough time to complete the Montessori tasks:

> *"…like with Montessori. There is not enough of us to do it, we can't give the residents an additional 10-15 minutes. We are with them for a half hour to get them ready, toilet, and then to bed. To find the time and sit and give them a one-to-one visit is virtually impossible. Half of us are doing our charting when our shifts are done… or we aren't taking breaks to make sure it's all done."*

Charting is of utmost importance as it ensures proper funding for all residents. When a resident is 'total care' the home receives less funding to perform the care tasks, as it is assumed that time is not needed to encourage the resident to help with the task (e.g. encouraging the resident to put in his or her own dentures). When a resident is deemed 'extended care', they, and the PSW need more time to complete the task because this care participation is encouraged. Thus, with extended care more government funding is provided. The recorded charting determines how much funding homes get for PSWs. These unfortunate time constraints effect everyday charting:

> *"…well you have to, there is only two people on the floor sometimes, you are going to get your residents ready first, right? But technically, if you don't do your charting then you didn't do* [the care tasks, thus funding is compromised]. *So, your kind of like stuck between a rock and a hard place."*

> *"…because we don't have enough time to be at the computer to answer the same questions over and over and over. I'd rather spend one on one time with the residents to talk."*

Participants agree charting is not very ergonomic nor functional:

> *"I would like the books back for charting. The reason they got them because* [management thought] *it would take less time and people were copying from one day to the next."*

> *"*[The charting] *is good, it is alright.* [However,] *the positioning on the walls are not good. They aren't ergonomic. They are supposed to be ergonomic. We should actually have someone come fit the height* [to our average] *…They just aren't in the right spot; your back aches, sometimes you just want to sit, or your arm hurts."*

> *"I would like to see our charting not at a kiosk on the wall because our backs are killing us…* [they should be] *portable where we could put it where we are comfortable, whether it be sitting… our whole shift we are on our feet. I used to love hand charting where I could sit. I stand leaning because I am in everyone's way."*

Unfortunately, PSWs are very rushed when completing care tasks, and participatory care is not always achieved:

> *"There is still not enough time to do a good job. To take the time that* [residents] *need to graciously accept the care they need, because you are forcing them into care half of the time. When I have to take someone to the toilet, but I have to because there are feces coming out of their pant leg and they don't want to be taken."*

Some participants spoke to feeding being compromised because of time constraints and lack of staffing:

> *"…but when you are in the dining room what do you do? There are several people to feed, people in bed to feed, and then what do you do? There's just not enough time. And the nurse can only help so much because she has to* [deliver] *the meds."*

Despite having minimal time to complete tasks, participants perceive that they go above and beyond for the residents and they feel that their role in the home is meaningful. They share a deep connection to many of the residents and staff as there is a strong community at the home.

The Realities of Care Workers' Daily Work and Tasks: The Personal is Political

Participants feel that they do not have any political say, nor opinions to be heard within the home. Participants infer their voices do not matter and are skeptical that technological innovations can occur. A participant spoke to their lack of political influence:

> *"It's reality; it's not a choice. We are on the bottom of the totem pole. We do the frontline and we do not get any respect. We know* [the residents] *their families, their facial expressions. We do so much more than what we are supposed to do. We have such a lack of respect—its horrible. We don't get set wages; some get $12* [an hour]."

DISCUSSION

At this long-term care home, technology reform is needed. Further, current technology should be improved to better suit the needs of staff and residents. As the results infer, their existing technology is functional albeit not ideal. The bed and door alarms are obtrusive to everyday mechanisms of the home, and institutionalize the environment and affect resident wellbeing. These alert-based technologies are especially intrusive to resident wellbeing when they have dementia, which applies to most, if not all of the resident population in this long-term care home.

Although essential, these technologies should be there to benefit the care and wellbeing of the residents instead of serving just an 'alert-based' purpose (e.g. sounding an alarm). This is achievable by replacing the wander guard bracelets with more appropriate mediums (i.e. watches, necklaces). If the technology is versatile, it can be applied to an array of resident personalities. For example, some older adults who have dementia enjoy wearing watches or jewelry. Unfortunately, technology in the home looks and feels institutional, which can impact residents. According to Andrews and Moon (2005), the therapeutic landscape of a care realm (e.g. in long-term care) influences the way residents perceive their health and wellbeing. Care realms should thus be more therapeutic, as opposed to institutional.

It is recommended that the home should improve upon relying strictly on alerts, by implementing less intrusive and institutional mechanisms. Specifically, this could be achieved by utilizing softer alerts, visual alerts, and/or having an alert system that directly notifies staff only. Many of these technologies do not appear to be available in Canadian care realms for older adults.

In regard to smart home technology, certain elements do have a place in this specific long-term care home. In Chan et al.'s (2009) Smart Home, telemonitoring is utilized to connect the patient to the externally-based health care practitioner and/or professional. Results show telemonitoring is needed to track resident wellbeing and to alert for falls. In addition to this, more preventative technology is needed to support resident wellbeing, especially when residents fall. Within physical support-based smart home technology, algorithm-based technology is able to track gait (Demongeot et al., 2002). Results indicate that tracking the gait of residents can help to prevent falls from occurring. This type of technology could benefit residents greatly, as falls have been

found to be the first indication of decline in older adults (Demongeot et al., 2002). Overall, more preventative measures are needed in this specific long-term care setting.

Care staff, especially nurses and PSWs, feel overwhelmed and overburdened. Technology innovation and implementation should seek to aid care staff, which in turn may improve resident care experiences, health and wellbeing. As care staff are currently experiencing time constraints with care-based tasks (i.e. toileting, bathing, washing, dressing), resident may suffer as a result. Other than increased PSW hours, participants perceive that care-based technology could potentially impact care delivery. Participants believe if innovative technology could allow the task to be easier, they could spend more time interacting with the resident during the task, instead of the resident *becoming the task.*

FUTURE RESEARCH

Future research should seek to understand whether these needed innovative technologies would function well in a long-term care setting. Further, additional research could help to determine the economic feasibility of such technologies. Perhaps this could be completed through a cost-benefit analysis.

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